Weather-driven Grape IPM Forecast Models and Decision Aids from the Network for Environment and Weather Awareness

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Our goal is to provide state-of-the-art, weather-driven grape IPM forecasts and viticulture decision aids to viticulture industries through the Network for Environment and Weather Awareness. In NY there are 31,000 acres of grapes producing 34 million dollars worth of fruit, ranking third in grape production nationwide (2005 Ag Statistics). The grape industry has been estimated in creating 3 billion dollars worth of economic impact in New York.

Objectives:
1) Grape IPM forecast models – Improve disease forecast output pages and test algorithms against grid sensors to predict leaf wetness; post insect models for research validation in NY; deploy downy mildew DMCast model for validation in Michigan; and provide disease models to Maryland Grape Growers Association.

2) Viticulture decision aids – Develop viticulture decision aides for evapotranspiration, cold temperature injury, vine phenology and harvest windows.

Progress Summary:
The grape disease models (powdery mildew, black rot, and Phomopsis cane and leaf spot) deployed in the Network for Environment and Weather Applications (NEWA) were migrated into the new NEWA website. Carroll, Weigle and Wilcox met to go over these models and plan for further improvement of their web pages. The Excel-based formulas for the grape disease models that have been deployed by

NEWA, with guidance from Cornell University scientists, were provided to the Maryland Grape Growers Association. The grapevine downy mildew model, DMCast, was re-programmed by the Northeast Regional Climate Center (NRCC) so it accesses their database of NEWA data and can reside in the new NEWA website frame. This version of the DMCast model is being reviewed by Seem. Anticipated availability of this simulation model is Feb 2010. Three Michigan weather stations, Clarksville, Fennville and Traverse City, were identified by Annemiek Schilder and Jeff Andresen, Michigan State University, for use in validating DMCast in Michigan.

Following rain events, hourly observations for presence of leaf wetness were made in labrusca and hybrid vines growing in Fredonia, NY and Geneva, NY and compared to NEWA-collected data from the leaf wetness sensors on the Fredonia (RainWise Inc.) and Geneva (Campbell Instruments) weather stations. At each location, observations were made after a total of four rain events (May-August). Weather station leaf wetness sensors were found to underestimate the hours of leaf wetness at both locations. Empirical models for estimating leaf wetness from weather data (temperature, dew point, wind speed, solar radiation) collected by the weather stations are being researched, with special emphasis on one the Maryland Grape Growers Association uses so we can validate its use in their weather network and possibly deploy it in NEWA.

Weigle met with entomologists Loeb, Cornell University, and Saunders, Pennsylvania State University, to discuss programming the grape berry moth phenology model in the NEWA system, to validate it and to make it available to growers on the website. An outline of possible model configuration including degree day base temperature and degree day accumulation action thresholds were sent to the NRCC for programming into the NEWA system. Under discussion is the biofix to start the model, either Vitis riparia bloom date, growing degree days, or a calendar date. Weigle and Loeb are exploring the use of specific vine phenology information in another funded grape berry moth project in order to correlate the V. riparia bloom date with Concord bloom to make the model easier to use.

NEWA's degree day tables were expanded to accommodate an April 1st accumulation start date which is utilized for grapevine and berry development by viticulture extension specialists, researchers and grape growers in NY. The berry curve, growing degree days (base 50F), has been used for Concord grapes to provide estimates of overall crop development in the Lake Erie region. Viticulturalists Bates and Creasap Gee have been analyzing the berry growth curve for hybrid grape varieties which assists growers in determining crop thinning and harvest windows in the Lake Erie Region. We met with the National Weather Service and began working toward improved freeze warnings which were experimentally broadcast in spring 2009. From the NEWA website we linked to information from Michigan State University on critical temperatures for fruit crops, detailing the temperature thresholds for cold injury to buds. We determined that the evapotranspiration (ET) model for grapevines is still in experimental development and not ready for field application; NEWA data from Fredonia and other sites has been used for ET model development by Lakso.

During 2009, at grape field meetings and grower conferences, Weigle and Carroll presented 25 talks on NEWA and its applications to vineyard IPM and risk management, reaching over 1100 audience members (Table 1).

Table 1. Presentations on NEWA given in 2009 by Weigle and Carroll.

Date	Title	Location	Audience	# of people
7-Mar	Weather Information for Vineyards – Available on NEWA	Finger Lakes Grape Growers Conf, Waterloo, NY	CCE educators, faculty and growers	60
18-Mar	NEWA Weather Information for Vineyard IPM	Lake Erie Regional Grape Growers Conf, Fredonia, NY	CCE educators, faculty, processors, & growers	150
24-Mar	Poster- The Network for Environment and Weather Applications (NEWA) Delivers IPM Forecasts for Fruit and Vegetable Crops	International IPM Symposium, Portland, OR	Scientists	50
10-Apr	Collaborations for Agriculture – NWS, NRCC, NEWA	NYSAES, Geneva, NY	NWS, NRCC ,& Cornell scientists	10
6-May	Information about using NEWA in early season	LERGP Coffee Pot meeting/Forestville, NY	Growers, members of grape industry	34
12-May	Using NEWA in developing a Vineyard IPM Strategy	New Grower Workshop	Persons interested in grape growing	14
13-May	Information about using NEWA in the early season	LERGP Coffee Pot meeting/Cambria, NY	Growers, members of grape industry	12
19-May	Use of NEWA in developing a scouting protocol	Finger Lakes Spring IPM Meeting	Growers, members of grape industry	150
20-May	Information about using NEWA in early season	LERGP Coffee Pot meeting/North East, PA	Growers, members of grape industry	33
3-Jun	Information about using NEWA in prebloom	LERGP Coffee Pot meeting/Westfield, NY	Growers, members of grape industry	22
4-Jun	Collaborations for Agriculture – NWS, NRCC, NEWA	NYSAES, Geneva, NY	NWS, NRCC ,& Cornell scientists	11
10-Jun	Information about using NEWA in prebloom	LERGP Coffee Pot meeting/North East, PA	Growers, members of grape industry	13
17-Jun	Information about NEWA for grape growers	LERGP Coffee Pot Meeting/Ransomville, NY	CCE & PSUE educators, faculty, & grape growers	21
24-Jun	Information about using NEWA at bloom	LERGP Coffee Pot meeting/Perrysburg, NY	Growers, members of grape industry	13
8-Jul	Using NEWA to calculate Growing Degree Days for GBM management	LERGP Coffee Pot meeting/Burt, NY	Growers, members of grape industry	12
19-Jul	Using NEWA in developing a vineyard IPM strategy	Cliffstar Growers Picnic	Growers	200
22-Jul	Using NEWA to calculate Growing Degree Days for GBM management	LERGP Coffee Pot meeting/Ripley, NY	Growers, members of grape industry	33
29-Jul	Using NEWA for downy and powdery mildew management	LERGP Coffee Pot meeting Silver Creek, NY	Growers	11
6-Aug	Using NEWA and scouting records to plan next season's vineyard IPM strategy	LERGP Twilight Meeting	Growers	150
12-Aug	Using NEWA to calculate Growing Degree Days for GBM management	LERGP Coffee Pot meeting Portland, NY	Growers, members of grape industry	36
10-Nov	Additions to the NEWA weather network in Seneca County	CRAVE, CCE Ag & Food Inservice, Ithaca, NY	Research and Extension faculty and educators	20
7-Dec	NEWA Train-the-Trainer Workshop	Hudson Valley Laboratory, Highland, NY	Eastern NY Extension educators & researchers	7
16-Dec	NEWA Train-the-Trainer Workshop	NYSAES, Geneva, NY	Western NY Extension educators & researchers	7

Multi-State Activities:
Michigan: Validation in Michigan of the downy mildew model for grapes, DMCast.
Maryland: Assisting the Maryland Grape Growers Association with setting up the grape disease models and field validation of an algorithm they use to estimate leaf wetness.

Expected and Observed Impact/Outcome:
Our goal is to provide state-of-the-art, weather-driven grape IPM forecasts and viticulture decision aids to viticulture industries through the Network for Environment and Weather Awareness (NEWA). Grape growers and extension personnel are sourcing weather information and pest forecast models from NEWA more often than in the past.

Improved IPM forecast model outputs in NEWA for four grape diseases and grape berry moth will enhance grape IPM, reduce pesticide inputs, and prevent crop loss. Deploying the berry curve growing degree day applications in NEWA will provide useful crop development information to grape growers. Collaborations with Michigan State University researchers and the Maryland Grape Growers Association will enhance grape IPM practice in those states, as well. The impact of this grape NEWA project will be to enhance the sustainability of vineyards, minimizing environmental impact, and maintaining profitability.

Investigation of leaf wetness algorithms may pave the way to augmenting or phasing out the use of leaf wetness sensor grids for NEWA models. Because leaf wetness sensors are not standard measurements gathered by weather instruments, this will allow the geographic coverage for plant disease forecasts to expand significantly, not only for grapes but for other crops.

Specific impacts in 2009 of this project include:

- The Maryland Grape Growers Association verified their disease forecast models were programmed correctly by comparing them to the files provided from NEWA.
- DMCast has been re-programmed so it can be deployed in 2010 and used by growers and extension educators in NY. Michigan State University is poised to validate DMCast in their vineyards at three locations.
- We now have improved grape web pages on the new NEWA website, newa.cornell.edu:
    - Grape Home Page http://newa.cornell.edu/index.php?page=crop-page-grapes
    - Grape Disease Models http://newa.cornell.edu/index.php?page=grape-diseases
    - Degree Days from April 1 http://newa.cornell.edu/index.php?page=degree-days
- The parameters for the grape berry moth degree day model have been agreed on by the researchers for validation in NY and PA.
- In 2009, ten grape growers and one researcher purchased and installed 11 weather stations in vineyards to connect to NEWA, ten in NY and one in PA.
    - In NY - Thirsty Owl Wine Company, Hosmer Winery, Three Brothers Winery, Shalestone Vineyards, Lamoreaux Landing Wine Cellars, Standing Stone Vineyards, Zugilbe Enterprise LLC, Swedish Hill Winery, Wagner Winery, and the Hudson Valley Laboratory.
    - In PA – Harbor Creek. Harbor Creek is the first grower-owned station located outside of NY that has been added to the network.
- This project has synergy with five other grant projects:

1. Seneca County Soil and Water Conservation District Service, grants to defray the growers' costs for the nine new weather stations.
2. Applying weather data and forecasts for managing crop inputs and reducing crop losses. Carroll. NE Center for Risk Management Education.
3. Grape downy mildew and grape berry moth: model reimplementation and redefinition for New York. Seem, Gadoury, Carroll, Weigle, DeGaetano, and Loeb. NYS IPM Program.
4. Testing the use of a degree day model to time control of grape berry moth. Loeb, Isaacs, Saunders and Weigle. Viticulture Consortium, LERGP, NY Wine & Grape Foundation.
5. Improved timing of control for the grape berry moth, *Paralobesia viteana*, using a degree day model. Saunders, Muza, Loeb and Weigle. USDA RIPM Northeast. (submitted)

- This summer, severe hail storms stripped leaves and fruit clusters from grapevines in several locations in NY, ruining the crop and damaging vines. Knapp Vineyards, Ernsberger Rd., Romulus, NY was particularly hard hit. NEWA personnel fielded calls to assist these growers in accessing data relating to this event for crop insurance.

Publications:

Carroll, J., Petzoldt, C., DeGaetano, A., and Weigle, T. 2009. Network for Environment and Weather Applications Delivers IPM Forecasts for Fruit & Vegetable Crops. 6th International IPM Symposium, Portland, OR. 1pp. http://www.ipmcenters.org/ipmsymposium09/019_Carroll_Network.pdf.

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Weigle, T., Loeb, G., Isaacs, R., and Saunders, M. 2009. Testing the use of a degree day model to time control of grape berry moth., Cornell Univ., NYS IPM Program, Geneva, NY. NYS IPM Program Project Reports 2008-2009, NYS IPM Pub No. 509, pgs. 98-100. http://nysipm.cornell.edu/grantspgm/projects/proj08/fruit/weigle2.pdf.

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Carroll and Weigle. 2008-2010. Weather-driven grape IPM forecast models and decision aids from the Network for Environment and Weather Awareness. Cornell Cooperative Extension, Smith-Lever $20,000.